

# FINAL REPORT

Contract #NAS8-36955, Delivery Order 71

## ANALYSIS OF MATERIALS FROM MSFC LDEF EXPERIMENTS

February 1990 — July 1991

Submitted to  
MARSHALL SPACE FLIGHT CENTER  
NATIONAL AERONAUTICS & SPACE ADMINISTRATION  
MSFC, AL 35812

Submitted by  
CENTER FOR APPLIED OPTICS  
UNIVERSITY OF ALABAMA IN HUNTSVILLE  
HUNTSVILLE, AL 35899

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In preparation for the arrival of the LDEF samples a material testing and handling approach was developed for the evaluation of the materials. A configured lab was made ready for the de-integration of the LDEF experiments. The lab was prepared to clean room specifications and arranged with the appropriate clean benches, tables, lab benches, clean room tools, particulate counters and calibrated and characterized analytical instrumentation. Clean room procedures were followed. Clean room attire and shoe cleaning equipment were selected and installed for those entering.

Upon arrival of the shipping crates they were taken to the lab, logged in and opened for examination. The sample trays were then opened for inspection and test measurements. The control sample measurements were made prior to placement into handling and transport containers for the flight sample measurements and analysis.


Both LDEF flight samples and LDEF type materials were analyzed and tested for future flight candidate material evaluation.

Both existing and newly purchased equipment was used for the testing and evaluation. Existing Space Simulation Systems had to be upgraded to incorporate revised test objectives and approaches. Fixtures such as special configured sample holders, water, power and LN<sub>2</sub> feed-throughs, temperature measurement and control, front surface mirrors for reflectance and deposition and U.V. grade windows had to be designed, fabricated and installed into systems to achieve the revised requirements.

New equipment purchased for LDEF analysis was incorporated into and/or used with existing components and systems. A partial list of this equipment includes a portable mono-chromater, enhanced U. V. System, portable helium leak detector for porosity and leak measurements, new turbo pumping system, vacuum coater assembly, cryopumps and analytical and data acquisition equipment.

The following list is of materials tested, equipment designed, fabricated and installed, systems used and analytical research accomplished on both LDEF flight samples and on similar materials which were lab tested for a comparative analysis to the LDEF flight samples.

1. **System** — Boeing Glass Atomic Oxygen Space Simulation System (AOSS)  
Equipment designed, fabricated and installed — U.V. water filter system to remove I.R. from U.V. lamps.  
**Test** — LDEF low-earth orbit U.V. simulation test.
2. **System** — Boeing Glass AOSS  
Equipment designed, fabricated and installed — 1st surface mirror test fixture .  
**Test** — U.V. light reflectance on a scale model of LDEF to simulate synergistic effects of contamination, U.V., and atomic oxygen.
3. **System** — Turbo pumped space environment system.  
Equipment designed, fabricated and installed — instrumentation and U.V. grade quartz window.  
**Test** — Controlled spectral illumination.
4. **System** — 4' X 6' space simulation system.  
Equipment designed, fabricated and installed — Sample holder and instrumentation feed-throughs.  
**Test** — Calibration for photo-conductivity testing of LDXEF type oxide coatings in a plasma environment.
5. **System** — Cross space simulation 2/X-25, 1 Kw U.V. system.  
Equipment designed, fabricated and installed — Sample holders, coolant and instrumentation feed-throughs.  
**Test** — U.V. test of silver teflon coated tape to simulate LDEF exposure of flight type samples for the purpose of duplicating optical degradation of LDEF flight samples.
6. **System** — SEYA NAMIOKA Monochrometer.  
Equipment designed, fabricated and installed — valves and operation sequence, LN<sup>2</sup> and cryosorb traps.  
**Test** — Optical analysis of LDEF samples.
7. **System** — Boeing glass AOSS.  
Equipment designed, fabricated and installed — A specimen chamber that includes various feed-throughs such as rotary, push-pull electrical & electro-mechanical.  
**Test** — Effects on LDEF type sample material in low-earth orbit environment.
8. **System** — Helium Leak Detector.  
Equipment designed, fabricated and installed — Sample material stamp die punch, and elastomer permeation test fixture.  
**Test** — Leak rate and porosity of elastomers in a simulated LDEF environment.

  
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R. Barry Johnson  
Principal Investigator

8/4/91  
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Date

The predominance of this effort was accomplished by Mr. Bobby Cothren.



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